Envisioning P4.0 in Organisation X with Lean Six Sigma and the Shingo Model

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Abstract

As a Fortune 500 multinational corporation in the energy and digital automation sector, Organisation X has made game-changing strides in the market with proprietary solutions and technologies aligned with the Sustainable Development Goals. Thereby, this study intends to explore the development of Procurement 4.0 (P4.0) via a Procure-to-Pay e-procurement software-as-a-service (SaaS) this contemporary organisation has adopted around 2 to 3 years ago – Coupa. Consequently, with a Lean Six Sigma DMAIC approach, this study aims to address 3 research objectives: (1) to understand the existing state of e-catalogue and PR approval flows in Organisation X's Singaporean and Malaysian entities, (2) unravel user perceptions towards Coupa and the Enablers and sift out potential impediments to efficiency in such processes, and (3) reimagine the future state of existing flows with proposed solutions. With a 57-question VOC involving the SERVQUAL+DM framework conducted upon 30 respondents, lean six sigma tools and a Japanese operational excellence model ingraining ideal e-procurement practices with Organisation X's employee value proposition, core values and proposed solutions, the study has successfully attempted to address its research objectives to reimagine how people, processes, and technologies could co-realise conducive e-procurement via Coupa.

Keywords
Lean Six Sigma, E-Procurement, the Shingo Model, Digital Transformation, DMAIC.

1. Introduction
Amid Industry 4.0 (I4.0) and digital transformation (DT), emergent technologies and human-centric practices are espoused by organisations who must react synchronously to transient market sentiments during hypercompetition (Akakikunda et. al., 2022; Rawat, 2023; Tay & Loh, 2020; Puschmann & Alt, 2005). Such paradigm shifts equally reverberate to procurement, birthing Procurement 4.0 (P4.0) (MIMInnovate, 2023). P4.0, alternatively e-procurement - is "an organisation's integrative deployment of information and communication technologies (ICT) to procure goods, information and services to fulfil business objectives" (Akakikunda et. al., 2022; Faheem & Siddiqui, 2019; Smart, 2010). Thereby, this study attempts to examine e-procurement processes in a contemporary enterprise such as Organisation X. As a Fortune 500 multinational corporation (MNC) in the energy and digital automation sector, Organisation X enables stakeholders to attain sustainable, game-changing business outcomes with proprietary solutions; thereby consistently soaring in accolades i.e. Corporate Knight's Global 100 Most Sustainable Corporations.

Organisation X's Indirect Procurement (IP) Ecosystem in Singapore and Malaysia
With regional headquarters in Singapore, there are **5** stakeholder types in the IP ecosystem. Firstly, the IP team mediates country-specific indirect spend matters for Organisation X's daily activities i.e. telecommunications, transportation, manpower, facilities management, R&D, catering and marketing. They would **(1)** negotiate for competitive terms with vendors, **(2)** analyse and report stakeholders' IP spend; and **(3)** oversee purchase request (PR) approvals and e-catalogue management on Coupa, a Procure-to-Pay (P2P) Software as a Service (SaaS) (Warder, 2022). Secondly, requestors are buyers who can submit or approve PRs and receive orders on Coupa for themselves, stakeholders, entities, or departments. This includes directors, managers, executive assistants, engineers, and Wellbeing Recreation Club (WRC) members. After PR approval processes are completed, auto-generated POs will be emailed from Coupa to vendors' inboxes, signifying consequent delivery. Finally, requesters will prompt the Finance

Department on received orders to initiate vendor payments. Thirdly, the Coupa team are "*website developers*" who will receive tickets attached with Excel files full of product metadata via ServiceNow - an employee support platform facilitating intra-organisational exchanges for tickets on onboarding, technical and IP issues (Khatri, 2018). Fourthly, the Proc Ops team are accountants who "*gatekeep*" alongside the Finance Department and tail spend subcontractor. Any discrepancies in submitted PRs will be questioned with the IP team, requestor, or stakeholders whom requestors are submitting for; otherwise, no approved PRs and vendor payments. Lastly, the SAP MDG team co-governs Coupa-integrated vendor accounts with commodity delegates on SAP Master Data Governance (SAP MDG): an Enterprise Resource Planning (ERP) software centralising metadata across multiple systems (SAP, 2023; Saarkoorpi, 2022). Hereafter, the IP, Proc Ops, Coupa and SAP MDG teams shall be collectively addressed as the Enablers.

1.1 Objectives
In this study, there are **3** research questions and objectives (RQs):
- **RQ1**: To understand the Voice of Customer (VOC) and illustrate AS-IS e-catalogue and PR approval processes in Organisation X's Singaporean and Malaysian entities with a 57-question Google Forms questionnaire and 2 deployment flowcharts**.**
- **RQ2**: To gauge and assess process lead times and perceived causes of inefficiency using a transactional VSM, Ishikawa Fishbone diagram and a hybridized SERVQUAL and DeLone and McLean's Model for Information Systems Success ("DM Model").
- **RQ3:** To use the Shingo Model aligned with Organisation X's employee value proposition and core values as a framework to achieve TO-BE e-catalogue and PR approval processes.

2. Literature Review
2.1. Exploring Case Studies of SaaS and E-marketplaces in B2B Procurement
In Pala et. al. (2019), a British leading contractor firm transitioned from an Electronic Data Interchange (EDI) to an ERP-integrated cloud-based SaaS; enabling buyers from diverse business units to shop for project and departmental needs. After adding required items into their carts, buyers will be redirected from vendor webstores back to the SaaS for PR filing and approval. This is similarly observed in Maassen (2020) where Genpact's Romanian pharmaceutical entity transitioned from SAP Ariba to Coupa. The IP team would progressively clarify with stakeholders on POs before approving them on the SaaS. Such POs would then be flown to the vendors for confirmation and subsequent delivery. With the SaaS, buyers could also liaise directly with vendors, submit multiple PRs without hopping across interfaces, enter fewer inputs with data automation and file more PRs with revised company policies. Thereby, the procurement team only intervenes when discrepancies exacerbate into high-tensioned disputes. Consequently, Mohd. et. al. (2013) examined contractors' perceptions of e-procurement in Malaysia, with usage (dependent variable, Y) and perceived ease of use, perceived usefulness, attitudes towards using and intention to use e-procurement (independent variables, X). Thereby, majority perceived e-procurement to be very useful. In retrospect, the case studies have successfully emulated P2P SaaS to address business-centric needs. Since Coupa is only deployed in Organisation X for **2** to **3** years, the DM model would be applied in RQ1 and RQ2 to assess user perceptions of Coupa.

2.2. Elevating Process Improvement with LSS in Contemporary Organisations
Phasinee et. al. (2018) conducted a single case study of Allied Generating Company (AGCo) - Thailand's energy supplier to provincial and national grids. Aforehand, AGCo's PO processing times preceded standard times. Thereby, the researchers pinpointed '*wastes*' for eradication with Value Stream Mapping (VSM) and the Ishikawa Fishbone Diagram. With **7** '*wastes*' abbreviated as "*DOWNTIME*", D, W, N and M were identified: **(1)** lack of employee training on SAP, **(2)** vendor sourcing times, and **(3)** stakeholder liaison times on missing data. (Phasinee et. al., 2018; Tay & Loh, 2020). The researchers proposed simplifying AGCo's Terms of Reference (TOR), training employees, modifying SAP system for vendor sourcing and liaison, and establishing monthly baseline processing times for the procurement team. Thereby, PO processing times sustained below baselines and met standard times. Consequently, Hamdani (2020) used the SERVQUAL model to appraise gaps between actual and expected service satisfaction of a bank's e-procurement system. Expectations preceded reality, with inefficient problem resolution efforts by employees as the key dimension for improvement. Thereby, for RQ2, the researcher will leverage on the SERVQUAL Model, a transactional VSM and an Ishikawa Fishbone Diagram to delineate key root causes, service quality of the Enablers and the **2** states of e-catalogue and PR approval flows in Organisation X.

2.3. Perceived Impediments to Efficiency in E-Procurement

Maassen (2020) also highlighted Genpact's challenges. Now, procurement personnel are expected to process orders promptly after PR submissions; raising confusion and time to resolve errors. Sometimes, the team would spill work over to holidays and rest days to meet promised deadlines while users submit incomplete orders to "*hide*" data on exclusive transactions. Thereby, extra time was devoted for PR amendment. Finally, the team received no email notifications on amendments in Ariba unless upon access. Beyond Genpact, Isikdag (2019) examines **4** e-procurement barriers: Technology, Market, Strategic and Human and Process in Turkey's construction industry with **(1)** engineers and architects cum buyers, and **(2)** e-procurement system providers. Thereby, most barriers were found to be Human and Process related. In retrospect, the human aspect is the most apparent barrier impeding sustainable e-procurement system usage. Thereby, the researcher will address how the human aspect deters efficiency in e-procurement in RQ2.

2.4. Evolving Technologies and their Associated Impacts for P4.0

Enraptured by digitalization, technological adoption is pervasively commonplace (Flechsig et. al., 2020; Corbos & Bunea, 2023; Tay & Loh, 2020). Thereby, market leaders are reimagining opportunities to amalgamate solutions for competent acquisition of strategic aims (Flechsig et. al., 2022; Corbos & Bunea, 2023). Flechsig et. al. (2022) conducted a case study with European purchasing and supply management (PSM) experts on Robotic Process Automation (RPA). With RPA, process times are slashed by automating mundane tasks after a few months for connectivity and scalability. Since RPA works 24/7, the experts also faced less pressure for headcount and outsourcing, reallocating their time to value-adding tasks. Lastly, RPA are inanimate bots unaverred by emotion, negating process errors. Such initiatives empower decision making from access to expansive data libraries to create more personalized offerings enhancing omnichannel value and relations (Makudza et. al., 2023; Tay & Loh, 2020; Pala et. al, 2019; Puschmann & Alt, 2005; Nicoletti, 2013). As an MNC, Organisation X must proactively redefine technologies, systems, and practices against encroaching rivals (Nicoletti, 2013; Puschmann & Alt, 2005). Thereby in RQ3, the researcher would explore how existing technologies could harmonize barriers to e-procurement process efficiency.

2.5. Reshaping Procurement for Organisational Success Amid I4.0

I4.0 has radically transformed procurement in contemporary organisations with disruptive technologies, business approaches and workplace practices (Chandrasekara et. al., 2020; Tay & Loh, 2021; Eskandrian et. al., 2016; Odi & Mas, 2020). But such initiatives are complex, so how could they achieve so? A suggestion would be to intermarry technologies with Kaizen and LSS (Bicer, 2022; Skalli et. al., 2022; Duy et. al., 2020). Kaizen (改善) is a Japanese philosophy advocating continuous change for the better. It inaugurates standards, then executes progressive actions in alignment for sustained improvements. Kaizen also revolves around "People, Standards and Process", where everyone nurtures an environment for collective decision-making and innovation without over-fixating on outcomes (Mui et. al, 2022; Duy et. al., 2020). Conversely, LSS produces quality offerings under optimal resource usage; and I4.0 explores ICT deployment to drive operations and stakeholder satisfaction (Macias-Aguayo et. al., 2022; Skalli et. al., 2022). Together, Kaizen + LSS + I4.0 mutate into a formidable equation for eventual success. In Eskandrian et. al. (2016), quality of **(1)** organisation culture and structure, **(2)** IT infrastructure and technology, and **(3)** knowledge management capability are affluent upon e-procurement success. The survey conducted on managers overseeing organisation-wide e-procurement systems deployment reflected **(1)** and **(3)** to directly influence e-procurement success. Thereby, organisations should embrace a culture fostering entrepreneurial innovation and cooperation for effective problem-solving. RQ3 aspires to emulate a cohesive coalition in Organisation X's Singaporean and Malaysian entities.

3. Methods

A real-life single case study design was conducted on Organisation X's Singaporean and Malaysian entities to understand whether existing e-catalogue and PR approval processes are efficient as per requesters' expectations and perceptions of Coupa and service administered by the Enablers (Crowe et. al., 2011; Tay & Loh, 2020; Priya, 2021). Guided by a readapted SERVQUAL+DM model and appropriate LSS methodologies, our study primarily adheres by "*Define, Measure, Analyse, Improve and Control*" (DMAIC) as shown in Figure 1. Yet, unlike the usual approach, "*Improve*" and "*Control*" shall be addressed together for RQ3 with appropriate philosophies and methodologies. Under "*Define*", the researcher delineated the scope, RQs and objectives with an AS-IS Deployment Flowchart. Under "*Measure*", the researcher conducted a VOC via a Google Forms questionnaire structured with the SERVQUAL+DM Model. Under "*Analyse*", the researcher deployed the SAS JMP software, an Ishikawa fishbone diagram and a transactional VSM to examine collected data. Lastly, in "*Improve*" and "*Control*", the Shingo Model aligned with Organisation X's employee value proposition and core values serve as a backbone for **3** proposed sub-solutions.
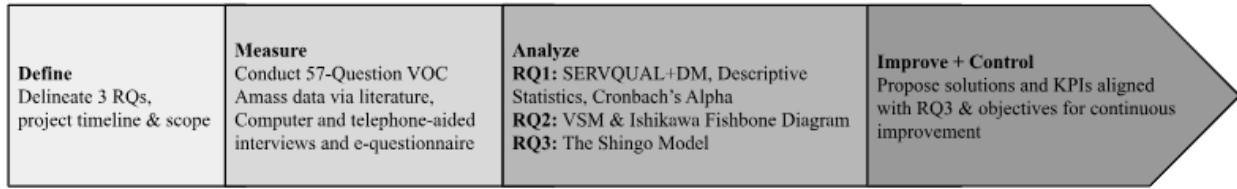
Define	Measure	Analyze	Improve + Control
Delineate 3 RQs, project timeline & scope	Conduct 57-Question VOC Amass data via literature, Computer and telephone-aided interviews and e-questionnaire	**RQ1:** SERVQUAL+DM, Descriptive Statistics, Cronbach's Alpha **RQ2:** VSM & Ishikawa Fishbone Diagram **RQ3:** The Shingo Model	Propose solutions and KPIs aligned with RQ3 & objectives for continuous improvement

Figure 1: Curated DMAIC Framework for Organisation X. (Source: Author, 2023).

4. Data Collection

A Voice of Customer (VOC) analysis was conducted from 18 September 2023 to 10 October 2023 based on feedback from the thirty (30) respondents via a Google Forms questionnaire, which comprises of 57 free response and multiple-choice questions (MCQs) structured in a 7-point Likert Scale. For instance: (1) Strongly Disagree, (2) Disagree, (3) Somewhat Disagree, (4) Neutral, (5) Somewhat Agree, (6) Agree, (7) Strongly Agree (Finstad, n.d.). However, every requester had varying levels of usage, whereby they would only submit or approve PRs without shopping through e-catalogues. Thereby, options with "0" and "NA" were permitted for applicable questions. Concurrently, in-depth interviews proceeded via Microsoft (MS) Teams, direct line, social networking applications and face-to-face (F2F) meetings to substantiate comprehension of requesters' expectations and perceptions of Coupa and the Enablers' services. Secondary data sources such as journal articles and whitepapers further illustrated the resolution of similar challenges in other organisations and industries with business-centric measures and sustainable outcomes.

5. Results and Discussion

5.1 Define

From the VOC analyses, respondents were from **9** over different departments i.e. Field Services, Global Supply Chain, Digital Innovation & Technology and Human Resources. Most of them were females (66.7%), from Global Supply Chain (26.7%), are EAs (33.3%), aged 25 to 34 (33.3%), and are under entities based in Singapore (76.7%). However, while the **76.7%** work under Singaporean entities, 16.67% oversee matters in both Singapore and Malaysia. This equally applies to the **6.9%** who are currently based in India and Indonesia respectively.

As shown in Table 1, there are **4** e-catalogue types on Coupa pertaining to over **25** key commodity and **100** sub-commodity types. With PunchOut being the most preferred e-catalogue type, the top **3** leading purchases on Coupa are **(1)** stationery and office equipment (50%), **(2)** safety equipment and tools (43.33%), and **(3)** manpower and human resources (33.33%) or engineering equipment and services (33.33%). Most respondents are daily users (40%), with over 2 years of experience (36.7%) and without approval rights (83.33%) or prior experience to it or an equivalent platform before current roles (80%). Lastly, respondents are generally in favor of disruptive technologies (83.33%).

Table 1: Types of E-Catalogues on Coupa. (Source: Author, 2023).

PunchOut	E-catalogues where requesters will be redirected to vendors' webstores integrated with Coupa for procurement, before returning to Coupa for PR filing and submission.
Hosted	E-catalogues which are "*searchable*" simply via the navigation bar.
Free Forms	E-catalogues standardized and specifically for manpower, electric vehicles, name tags and name cards.
Forms	E-catalogue where requesters could manually write what they wish to buy, particularly for products and vendors that cannot be found on the other 3 e-catalogue types

Figure 2 illustrates AS-IS deployment flowcharts for existing e-catalogue and PR approval flows in Organisation X's Singaporean and Malaysian entities. Based on "*DOWNTIME*", respondents expressed long waiting times (W) for the Enablers to debug and revert to them on highlighted issues on Coupa; and for approvers to review and approve submitted PRs. For N (Not Utilizing Talent Properly), respondents shared uncertainty in where they could access specific **existing** products or vendors on Coupa. Thereby, they would reach out to applicable Enablers repetitively for re-training and clarification, resulting in unnecessary motion (M) and workload (E).
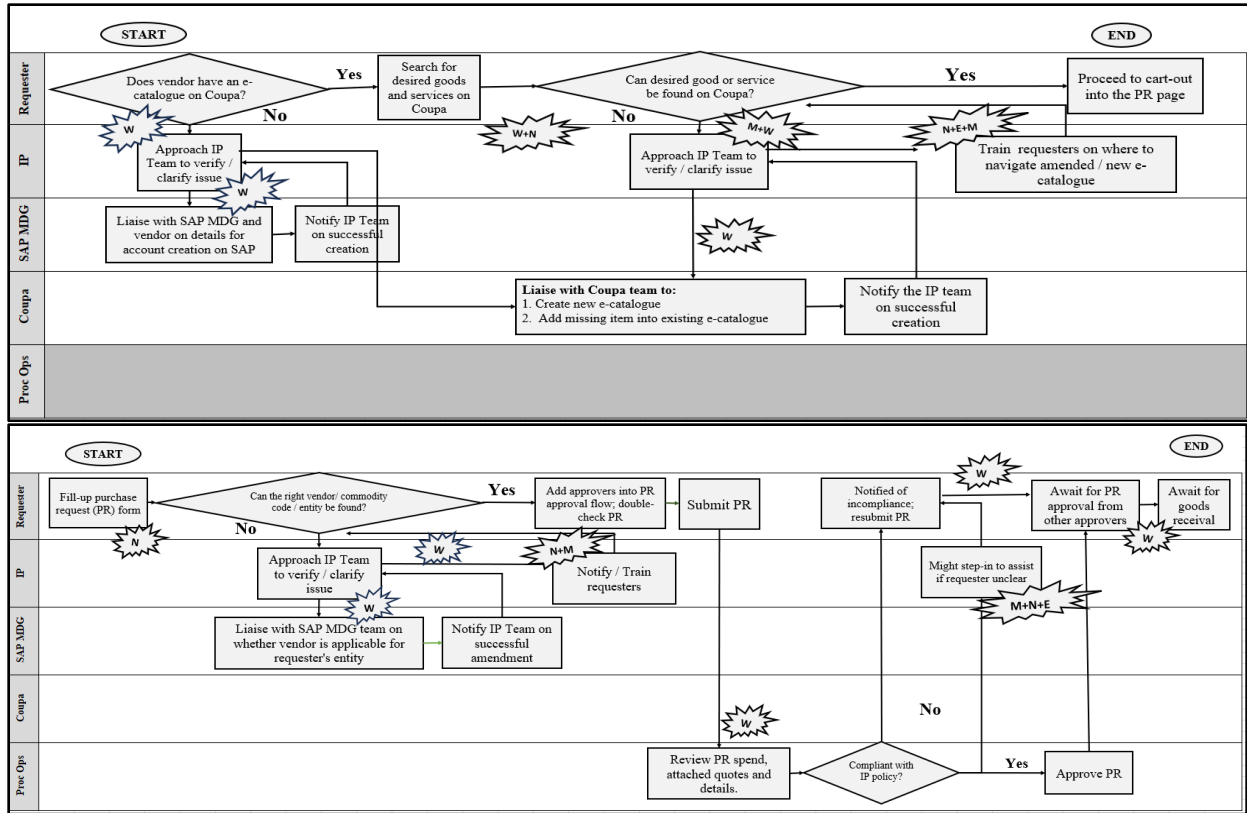
Figure 2: AS-IS Flowchart Deployment for E-Catalogue (*Top*) and PR Approval (*Bottom*) Flows.
(Source: Author, 2023).

5.2 Measure

Due to time and spatial constraints to map transactional VSM diagrams illustrating all information flows over Coupa and other IT systems, the researcher focused on average lead times for both e-catalogue and PR approval flows in 1 requester's perspective as shown in Figure 3 (Pereira, 2021). Behind the 30 respondents, there are 250 stakeholders and 84 subsequent approvers. Lead times are computed in weeks and inclusive of respondents' usual durations and frequency of times to (1) browse for desired products via the 4 e-catalogue types, (2) clarify with the Enablers, vendors, or colleagues, and (3) wait for approval processes to be completed for PO issuance on Coupa. Generally, actual lead times only met expectations of 4 respondents, with I/T preceding C/T by 88.316% as shown in Table 2.

Table 2: Comparison Between Actual and Expected E-Catalogue and PR Approval Process Times.
(Source: Author, 2023).

	Actual (in weeks)	Expected (in weeks)
Cycle Time (C/T)	250.451	1.762
Idle Time (I/T)	4,036.50	1,588.86
Total Process Lead Time (TPLT)	4,286.95	1,590.62

% of Cycle Time (C/T) / Total Process Lead Time (TPLT) = 250.451 / 4.286.95 = <u>5.842%</u>
% of Idle Time (I/T) / Total Process Lead Time (TPLT) = 4,036.50 /4,286.95 = <u>94.158%</u>
Difference between C/T and I/T = 94.158% - 5.842% = <u>88.316%</u>

Lastly, 5 respondents used Coupa primarily for approval without gauging time of usage amid other commitments i.e. overseeing IT operations for 3 countries, thereby their responses contributed more towards the 9 problem statements under the 6 constructs of the SERVQUAL+DM Model in Section 5.3. Here are the 9 problem statements.

Problem Statements:
H1: Information Quality (IQ) favourably influences Usability/Use (U)
H2: System Quality (SQ) favourably influences Usability/Use (U)
H3: Service Quality (SEQ) favourably influences Usability/Use (U)
H4: Information Quality (IQ) favourably influences User Satisfaction (US)
H5: System Quality (SQ) favourably influences User Satisfaction (US)
H6: Service Quality (SEQ) favourably influences User Satisfaction (US)
H7: Usability/Use (U) favourably influences User Satisfaction (US)
H8: User Satisfaction (US) favourably influences Usability/Use (U)
H9: Usability/Use (U) favourably influences Net Benefit (NB)

5.3 Analyse
5.3.1. Descriptive Statistics and Cronbach's Alpha Reliability Test
Cronbach's Alpha (α) was used to ascertain reliability of responses, adhering as follows: Excellent (>=0.9), Good (0.8 to 0.89), Acceptable (0.70 to 0.79), Questionable (0.60 to 0.69), Poor (0.5 to 0.59) and Unacceptable (<0.5) (Prianto & Seyadi, 2023; Ghoni, 2022). Eventually, an overall α of 0.898 was derived (Good), with each construct's α falling under Acceptable except for SQ. Thereby, with lower reliability for SQ, follow-up interviews were required for validation. Consequently, since data was primarily collected with a 7-point Likert-scale, the range for mean scores are as follows: Very Low (1.000 - 1.857), Low (1.858 - 2.714) Somewhat Low (2.715 - 3.571), Neutral (3.572 - 4.429), High (4.430 - 5.286), Somewhat High (5.287 - 6.143) and Very High (6.143 - 7.00). Generally, respondents held neutral to high perceptions of every construct under the SERVQUAL+DM Model shown in Figure 3.

Information Quality (IQ)
With an α of **0.774** and mean Likert score of **4.200-4.433**, respondents held neutral perceptions on whether searches were relevant after hitting "*Enter*" on Coupa (IQ1) or if data on Coupa corresponds with quotations and deliveries (IQ2); whether data was sufficient and adequate to induce purchases (IQ3); and whether they "*like*" the PR template design (IQ4) and Coupa's current aesthetic outlook (IQ5).

System Quality (SQ)
With an α of **0.441** and mean Likert score of **4.433-5.067**, respondents perceived SQ to be high; rarely taking long to execute commands (SQ1) or experiencing system or connectivity issues (SQ2); receiving timely updates via email or Coupa after tasks are completed (SQ3); and feeling that Coupa has the necessary functionalities and features to run their tasks (SQ4) with flexible enough PR approval flows (SQ5).

Service Quality (SEQ)
With an α and mean Likert score of (**0.735; 4.867-5.500**) for Perceptions and (**0.925; 5.800-6.167**) for Expectations, respondents held high perceptions and expectations. Yet, **20** respondents reflected negative gap scores, implying perceived SEQ of the Enablers to be lower than expected. Generally, the Enablers were supportive and friendly (SEQ1), with timely data updates (SEQ2), adequate problem resolution (SEQ3) and guidance for learning of Coupa (SEQ4).

User Satisfaction (S)
With an α of **0.773** and a mean Likert score of **4.600-5.267**, respondents are highly satisfied with product price and quality (S1); learning resources (S2); how Coupa is currently functioning (S3); and the technical and administrative support that they get from the Enablers (S4).

Usability / Use (U)
With an α of 0.886 and mean Likert score of 4.500 - 5.067, respondents perceived Coupa to be somewhat or highly usable or easy to use anytime and anywhere (U1) to search, order, and checkout what they need (U3); and to fill and submit PRs (U4) or to learn how to use (U5). Yet, most agreed that having prior experience to Coupa or an equivalent platform would ease current usage (U2).

Net Benefits (NB)
With an α of **0.929** and mean Likert score of **4.567-4.967**, respondents perceive net benefits to be high such that they feel productive when performing tasks on Coupa (NB1) as a productive platform for e-procurement (NB2) and

effective stakeholder collaboration (NB3); potentially recommending Coupa to non-users (NB4) since it meets their expectations and needs (NB5).

5.3.2. Linear Regression Analyses
With SAS JMP, linear regression analyses were conducted upon the mean scores of each respondent and construct under the SERVQUAL+DM Model shown in Figure 3 to assess the influence of independent (X) variables upon dependent variables (Y) upon each other (Odi & Suryani, 2020; JMP, n.d.). Thereby, our independent variables are IQ (X1), SQ (X2) and SEQ (X3); against dependent variables: U (Y1), S (Y2) and NB (Y3). Significance level (*p-value*) adhere by: **<0.01** (*very significant*), **<0.05** (*Significant*) and **>0.05** (*Insignificant*) (Odi & Suryani, 2020).
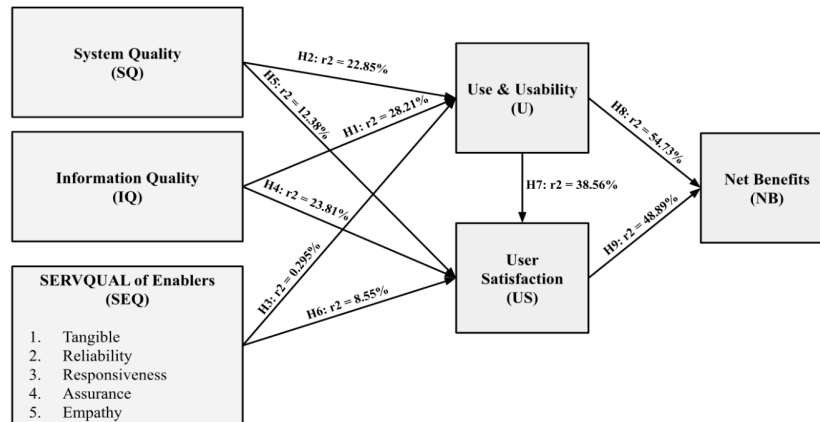
Figure 3: SERVQUAL+ DM Model (Source: Author, 2023).

Thereby as shown in Figure 3 and Section 5.2, the **9** hypotheses for the **6** constructs of the SERVQUAL+DM Model shall be as follows:

H1: Information Quality (IQ) **positively** influences Usability/Use (U)
The influence of the IQ (X1) upon U (Y1) is **28.206%.** With a correlation of around **53.109%**, significance value of less than **0.0025** and a value of **3.32**, **H1** is accepted as IQ **significantly and positively** influences U.

H2: System Quality (SQ) **positively** influences Usability/Use (U)
The influence of SQ (X2) upon U (Y1) is around **22.849%.** With a correlation of around **47.801%** and a t-value of **2.88**, **H2** is accepted.

H3: Service Quality (SEQ) **positively** influences Usability/Use (U)
The influence of SEQ (X3) upon U (Y1) is around **0.295%.** With a correlation of around **5.432%** and a **t**-value of **0.29**, **H3** is accepted.

H4: Information Quality (IQ) **positively** influences User Satisfaction (S)
The influence of IQ (X1) upon S (Y2) is around **23.814%.** With a correlation of **48.8%,** significance value of **0.0062** and a **t**-value of **2.96**, **H4** would be accepted, ascertaining that IQ **positively and significantly** influences S. Like **H1**, IQ influences respondents' perceived usability and satisfaction of Coupa, thereby a priority variable for **Section 5.4**.

H5: System Quality (SQ) **positively** influences User Satisfaction (S)
The influence of SQ (X2) upon S (Y2) is around **12.381%.** With a correlation of **35.187%** and a **t**-value of **1.99**, **H5** is accepted.

H6: Service Quality (SEQ) **positively** influences User Satisfaction (S)
The influence of SEQ (X3) upon S (Y2) is around **8.545%.** With a correlation of **29.232%** and a **t**-value of **1.62**, **H6** is accepted.

H7: Usability/Use (U) **positively** influences User Satisfaction (S)

The influence of U (Y1) upon S (Y2) is **38.559%.** With a correlation of **62.096%,** significance value of **0.0003** and a **t**-value of **4.19**, **H7** is accepted, ascertaining that U **significantly and positively** influences S. Thereby, one's perceived usability and ease of usage of Coupa can influence their satisfaction towards the SaaS.

**H8:** Usability/Use (U) **positively** influences Net Benefit (NB)
The influence of U (Y1) upon NB (Y3) is **54.726%.** With a correlation of **73.977%,** significance value of **<0.001** and a **t**-value of **5.82**, **H8** is accepted, ascertaining that U **significantly and positively** influences NB.

H9: User Satisfaction (S) **positively** influences Net Benefit (NB)
The influence of U (Y1) on NB (Y3) is **48.889%.** With a correlation of **61.918%,** significance value of **<0.001** and a **t**-value of **5.17**, **H9** is accepted as S **significantly and positively** influences NB. Like **H8**, satisfaction has a **direct** relationship with perceived net benefits. Thereby, NB and S would also be priority variables in **Section 5.4**.

5.3.3. Root Cause Analyses (RCA)

With our problem statement as the "*fishbone's head*", causes to inefficiency in Organisation X's e-catalogue and PR approval processes were mapped out using the Ishikawa Fishbone Diagram shown in Figure 4 (Gitlow et. al., 2015).
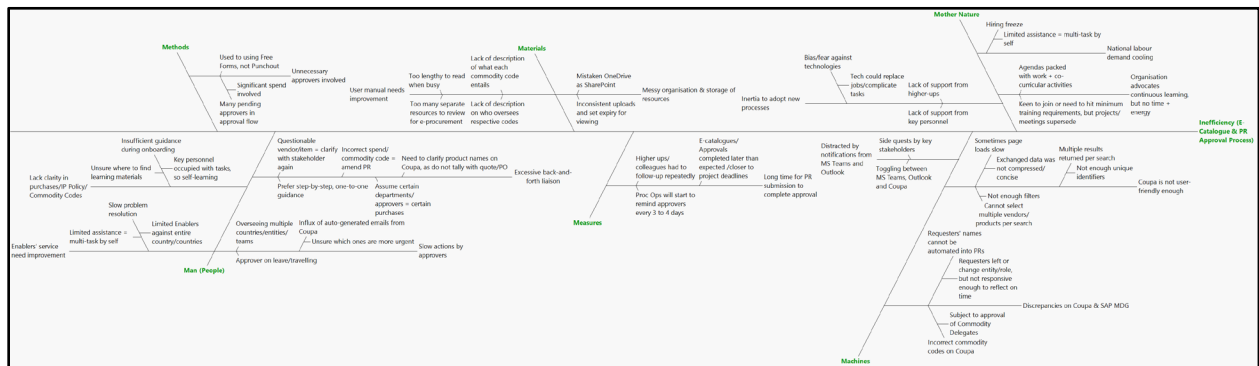
Figure 4: Ishikawa Fishbone Diagram Populated by SAS JMP. (Source: Author, 2023).
[Higher resolution fishbone diagram is available upon request.]

Mother Nature
With colleagues who resigned or transferred to another role amid a hiring freeze and weak economic outlook, some respondents assumed additional responsibilities (The Malaysian Reserve, 2023). Although Organisation X advocates continual learning, respondents found it stressful to juggle co-curricular commitments atop of packed agendas via Offline-to-Online (O2O) training and WRC programmes. Lastly, most respondents held a bias or fear against disruptive technologies despite **83.33%** acknowledging them as harbingers of efficiency above the Likert score of **4**.

Machines
Aside from slow webpage loading, respondents could not select multiple products and vendors, thereby returning occasionally irrelevant results. Contradictorily, respondents expressed frustration for "*flipping*" multiple pages. Secondly, **10%** of respondents expressed difficulties in finding niche components or maintenance and testing services for specific lab equipment. It is tricky to simply find substitutes from alternative vendors. Thirdly, requesters had to manually key in details for PR due to slow integration between SAP MDG and Coupa after stakeholders' resignation or transfer. Lastly, selective data on Coupa are reflected incorrectly despite co-governance.

Materials
Respondents consensually expressed confusion on which database to store and share critical information. Currently, Organisation X uses MS Teams, OneDrive, and SharePoint, with occasionally inconsistent uploads and viewing periods. Thereby, some media can be "*late*" or "*missing*". Most respondents also found the IP policy and user manual too lengthy for reading, with a lack of information i.e. what each commodity code entails and who oversees them. Thereby, respondents would either file PRs wrongly or liaise repetitively with in-line managers and the IP team.

Measures

To gauge whether e-catalogue problem resolution or PR approval flow is "*long*", requesters would be "*chased*" repetitively by managers or colleagues. With incomplete approval processes, the Proc Ops team would start reminding the approvers every **2** to **3** days. Lastly, certain vendors lack accessibility to other entities on SAP MDG due to erratic and insignificant spend. Thereby to control organisational spending, the SAP MDG team or global commodity delegates would "*block*" such accounts; leading the IP team to approach them repetitively for re-enablement on Coupa.

Methods

To simplify product identification, the Enablers standardized product naming conventions on Coupa. Contradictorily, requesters found it easier to find products with the initial conventions because of its uniqueness when tallying with quotations for PO issuance. Thereby, the IP team had to schedule back-to-back calls to ease confusion. Secondly, requesters tend to be distracted by notifications from stakeholders on MS Outlook and Teams.

Man (People)

Firstly, **16.67%** of respondents cum approvers would still fail to approve PRs on time despite reminders from Proc Ops as they were on leave; are overseeing multiple teams, divisions, and countries; or are apprehensive of approving selective PRs due to significant spend or dubious details. Secondly, the Singaporean and Malaysian IP teams only consist of 3 people, with the Malaysian IP leader overseeing IP matters for Malaysia and Taiwan alone. This sentiment is shared by **83.33%** respondents who hoped that someone else would do the job for them. Lastly, **56.67%** of respondents faced insufficient peer support and steep learning curve as they could not consult others during onboarding, particularly from their leaders cum approvers.

5.3.3.1. Summary

Root causes were: **(1)** inadequate user manual; **(2)** steep learning curve; **(3)** slow approval actions, **(4)** back and forth liaison and **(5)** lack of peer support. This is corroborated by Section 5.3.2 where IQ, U and S were found to significantly influence requesters' usage of Coupa. However, since information is exchanged via virtual mediums such as MS Teams, Coupa and SAP MDG, system quality would still be considered despite lower p-value at a lower priority.

5.4 Improvement and Control Phase

Conceived by the brain behind the Toyota Production System, the Shingo model has 5 elements and 10 guiding principles to actualise sustainable enterprise-wide transformation (Sa et. al., 2022; Kelly & Hines, 2019). Thereby, the Shingo Model could be interweaved into Organisation X's Singaporean and Malaysian IP ecosystem for a more sustainable and conducive e-procurement culture.

5.4.1   Balancing "*Why*", "*Who*" and "*How*"

As frequent users of Coupa, requesters are key "*customers*" and "*sources*" of value in Organisation X's e-procurement flows. Yet, occasional over-emphasis on cost reduction and results attainment with imbalanced synergies between organisational culture, people, processes, and technologies can invoke short-lived DT initiatives despite significant investment (Tabrizi et. al., 2019; McKinsey & Company, 2018). Thereby, aside from being more human and process-oriented, key Enablers and approvers who are organisational leaders could co-conduct VOC, RCA and VSM on **requesters** via the structured DMAIC like in Chapter 4 to understand their journey of "*how*" **and** "*why*" inefficiency in e-catalogue and PR approval processes remain despite embarking on DT with Coupa 2 to 3 years ago.

5.4.2   Delineate Ideal Behavioural Standards

Based on delineated root causes, the following solutions would be executed to enforce ideal behaviours for ideal outcomes. **Firstly**, construct a MS Teams group involving requesters, approvers and the Enablers using the 5S methodology, which stands for **Sort** (*Seiri*), **Set to Order** (*Seiton*), **Shine** (*Seiso*), **Standardize** (*Seiketsu*) and **Sustain** (*Shitsuke*). In today's age where contemporary organisations are venturing into the virtual realm with e-databases, this concept could be explored "*non-tangibly*" despite literature illustrating it more "*tangibly*" in a warehouse or production site setting (Tay & Aw, 2021; Muotka et. al., 2023; Tahasin et. al., 2021, Hernández Lamprea et. al., 2015).

Seiri (整理)

Seiri implies: "*Remove what you do not need and leave only what you need.*" MS Teams, OneDrive and SharePoint fulfil primarily different purposes despite being in sync with each other. Thereby, since respondents dislike "*hopping*" across multiple interfaces, **MS Teams** shall be the key platform for communications **and** resource sharing.

Seiton (整頓)

Seiton implies: "*In whatever remains, categorize and arrange neatly for easier identification and use*". Information can be categorised into new channels, folders and sub-folders as shown in Figure 5 based on the nature of documents and discussions. For instance: "*Indirect Procurement Policy*" and "*Frequently Asked Questions (FAQ)*". For easier identification, add a date behind each folder name i.e.: "*IP Webinar (SG) 23Sept2023*".

Seiso (清扫)

Seiso implies: "*Embark on a regime to "clean" the areas you wish to improve on.*" In **1** to **2** days, a selected team of Enablers, requesters and approvers could upload necessary multimedia and co-govern the MS group periodically. Channel members would adhere by a standardized list of housekeeping rules and naming conventions. Lastly, set the expiry date to "*These links never expire*" in the admin centre and click "*Save*" to ensure accessibility to resources, particularly for new internal stakeholders in the IP ecosystem (Plumley, et. al., 2023; Gussin, 2022).

Seiketsu (清洁)

Seiketsu implies: "*Consistently repeat this regime regularly.*" A disclaimer message, as shown in Figure 5, could be pinned in the main channel to inform members on who to look for, what to upload, how to navigate, and where to access relevant multimedia. Additionally, illustrations on specific uses of each MS application and IP could be periodically shared for more impressionable references, reducing confusion and inconsistent uploads.
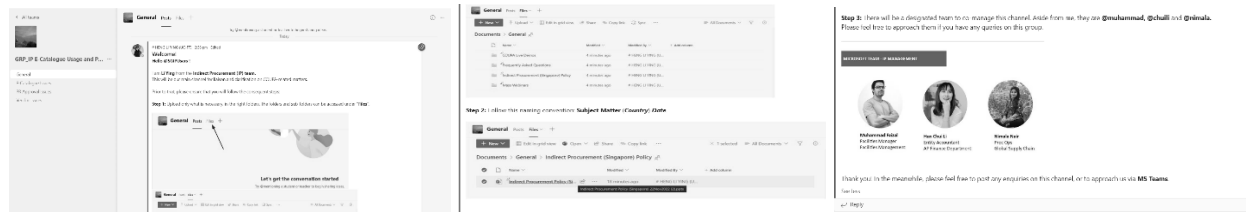

Figure 5: MS Teams IP Group (Source: Author, 2023).

Shitsuke (躾)

Shitsuke implies: *"Ingrain this into your ways of working and living of life".* **Every** user should cultivate the discipline to co-maintain the channel. Thereby if any of the team members are incapacitated by illness or responsibilities, **anyone** could conduct routine checks. Eventually, conscious efforts would benefit not only individual users, but **everyone**.

In this MS Teams group, there will also be one channel restricted to the Enablers and commodity delegates to improve data reconciliation and automated PR filing on Coupa via periodic reviews on SAP MDG. This channel will be embedded with a **free** MS Teams-Coupa Connector plug-in, which will notify approvers on pending e-procurement activities via pop-up messages and redirect them to Coupa from wherever they are and whatever device used i.e. IOS or Android (Coupa, n.d.). It would be justifiable for requesters to procure for projects with significant spend; otherwise subjected to case-by-case approval. Thereby, internal stakeholders in the IP ecosystem could bridge connections with each other on pending e-procurement activities via extra "*alarm clocks*" such as real-time comments, mentions and reminders **anywhere and anytime**; enhancing efficacy, compliance and transparency in communications and actions.

Secondly, as shown in Figure 6, a user manual + IP policy video guide can be accessed via Coupa, Organisation X's e-learning portal and the new MS Teams group to ease usage of Coupa. Key information i.e. number of quotations per spend limit, what each commodity code entails, and who governs each commodity code shall be voiced over by various department representatives in subsections. This video can also be replayed multiple times in different languages and playback speeds. Thereby, internal stakeholders could address some queries autonomously while submitting or approving fewer PRs with incompliant spend and information; slashing time for PR amendment, clarification, and approval and granting the Enablers more time to address complex issues. If certain sections are inapplicable, click on other timestamps to skip or download selective segments, consulting the IP team only when uncertain post-review.

Figure 6: Mock-up of New Video User Guide (*Left*); Products Page (*Right*) (Source: Author, 2023).

Thirdly, the Enablers could leverage on search engine optimisation (SEO) to elevate User Experience (UX) and User Interface (UI) design: practices to enhance a website's functionality and design for an efficient end-to-end (E2E) journey (Lamprecht, 2022; Yalçin & Köse, 2010; NeilPatel, n.d.). Based on navigational, informational, and transactional user intent; consistently improve Coupa's sitemap, breadcrumb lists and performance reports to link relevant pages to queries (NeilPatel, n.d., Google, n.d.). Consequently, compress product images and use Latent Semantic Indexing (LSI) and "*alt*" labels to quicken page loading and search results (Google, n.d.; Yalçin & Köse, 2010). Finally, keep title and description labels concise without symbols; and create a filter menu and collapsible list to specify number of results per page i.e., 25, 50 or 100, as shown in Figure 6 (Yalçin & Köse, 2010; Google, n.d.).

5.4.3 Visualise and Reinforce Shared Values and Commitments

To gauge current e-procurement performances and to ascertain which aspects stakeholders ought to improve or sustain, the Enablers could broadcast visual management boards or balanced scorecards of current e-procurement performances periodically via the new MS Teams group to remind all parties of a shared vision and commitment. Gemba walks and performance reviews would also be conducted to monitor monthly or annual performances, and correct incompliant actions whenever spotted in the IP ecosystem. If some actions do not meet expectations, patiently listen and work on requesters' "*why*" before suggesting corrective solutions to user-centric issues.

5.4.4 Reward and Sustain Performances for Ideal Outcomes

Lastly, to advocate all parties in the Singaporean and Malaysian IP ecosystem to sustain and surpass current performances, award, or recognise employees who have exemplified ideal e-procurement practices via annual townhall events, recognition programs or posts on Organisation X's Yammer, LinkedIn, the new MS Teams group and Outlook. Sometimes, employees do not expect retribution for their efforts, but an open and supportive space to admit, learn new insights and grow from their mistakes for the better (Behind the Scenes, n.d.).

5.5 Summary

Despite "*trivial*" changes to how existing technologies, human talent, capabilities, and processes are managed; the researcher aim to foster a balanced synergy aligned with Organisation X's core values and employee value proposition, which is: "*empowering all to deliver innovative and customer-centric outcomes, while challenging the status quo and learning progressively daily*" to drive process efficiency and manifest ideal outcomes. Furthermore, the Shingo Model embodies a form of *Kaikaku:* a reform in existing behaviors and environment. Thereby, the Enablers, approvers and requesters could not only establish more pragmatic, equitable, inclusive, and transparent mechanisms for effective support, learning and collaboration via Coupa; but cultivate shared commitments, habits, and mindset for continuous improvement to co-realise a conducive e-procurement culture in Organisation X (Forth et. Al, 2020, ICG, 2023).
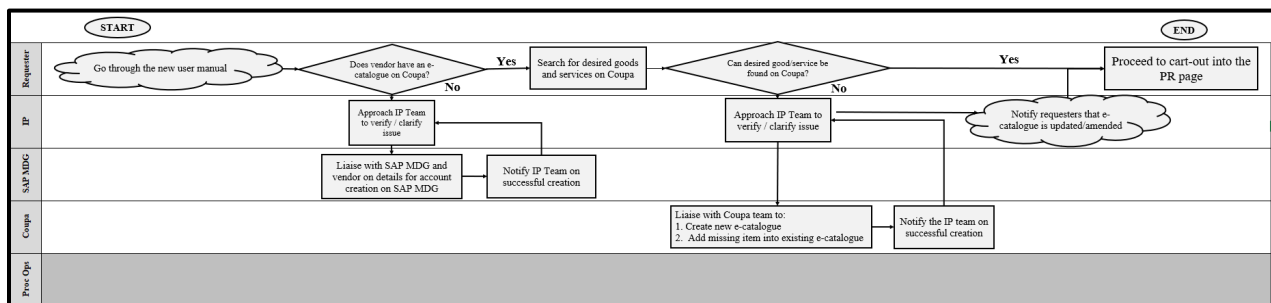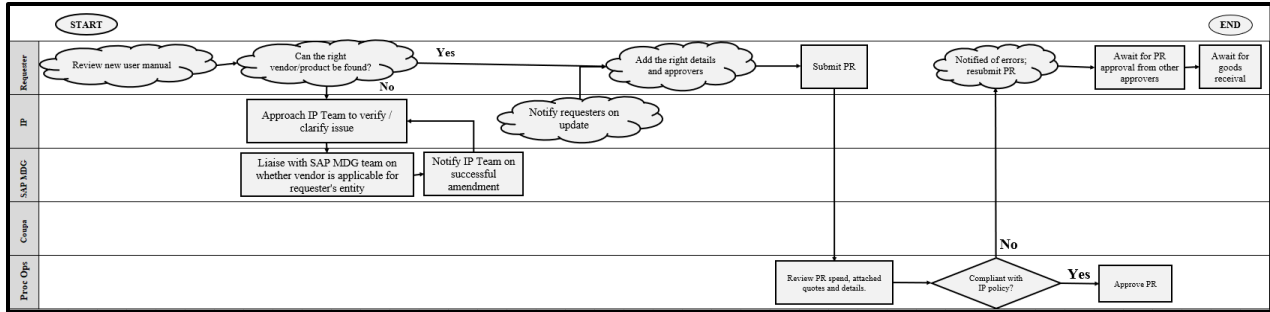
Figure 7: TO-BE Deployment Flowcharts for E-Catalogue (*Top*) and PR Approval (*Bottom*) (Source: Author, 2023)

Based on Figures 7 and 8, the TO-BE state would now involve fewer back-and-forth liaisons and data exchanges for existing products and vendors on Coupa for PR resubmission/retraining/re-clarification, leaving behind just 15 minutes for guidance. Thereby, assuming if expected lead times are met with optimised searches, communications, and data accuracy on Coupa, the TPLT could improve by **84.779%** in the TO-BE state as shown in Table 3.
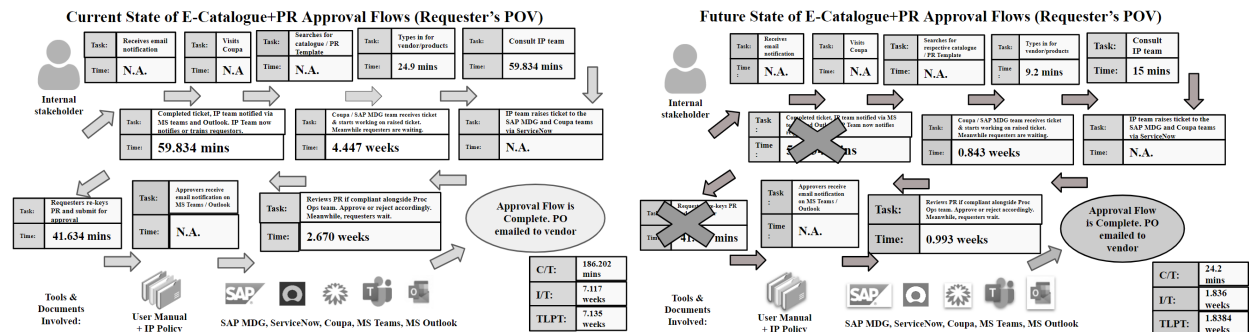
Figure 8: Current (*Top*) and Future (*Bottom*) Transactional VSM with Average Lead Time (Source: Author, 2023).

Table 3: Comparison of durations spent for AS-IS, Respondent's Expectations and TO-BE (Source: Author, 2023)

	AS-IS	Expected	TO-BE
Total C/T (in weeks)	250.451	1.762	1.309
Total I/T (in weeks)	4,036.50	1,588.86	325.60
Total PLT (in weeks)	4,286.95	1,590.62	652.51
% Improvement		62.896%	84.779%

6. Conclusion

Despite a paucity in literature, this study contributes to the deeper understanding of P2P processes involving diverse commodity types and business units for IP with LSS DMAIC and methodologies, the SERVQUAL+DM Model and the Shingo Model to (1) address real-world issues by an MNC, (2) recommend feasible solutions aligned with its core values and employee value proposition, (3) and reimagine efficiency in existing processes in its Singaporean and Malaysian entities. RQ1 was answered by conducting a VOC on 30 respondents with a 57-question survey and follow-up interviews to derive requesters' perceptions and expectations towards (1) existing IP process lead times and (2) perceived performance of Coupa and the Enablers based on 6 constructs of the SERVQUAL+DM Model: IQ, SQ, SEQ, U, S and NB. Consequently, RQ2 was answered by analysing responses with an Ishikawa Fishbone Diagram, transactional VSM, Cronbach Alpha's reliability test and descriptive statistics to ascertain the profile of respondents, the validity of responses, and to single out root causes to inefficiency in processes. 9 problem statements were further answered using linear regression analyses on the SERVQUAL+DM Model, highlighting IQ, U and NB as significant influencers. Lastly, RQ3 was answered by using the Shingo Model to foster a conducive e-procurement culture.

7.   Research Limitations

Firstly, data collection was restricted primarily to requesters and e-catalogue and PR approval processes in Organisation X's Singaporean and Malaysian entities. With liberty of time, more vendors, other country IP managers and Enablers based across East Asia and Japan (EAJ) and India be included. Secondly, only when everyone is willing and capable to continuously innovate and improve, can there be organisational success (Kelly & Hines, 2019). Thereby, it would take everyone's effort to enact proposed solutions for fruition. Thirdly, real-life procurement flows are far more complex than what could be captured in this study. Lastly, 1% of respondents who oversaw Organisation X's e-catalogue and PR approval flows for either Singapore or Malaysia is based beyond the 2 countries (India and Indonesia). Likewise due to time limitations, the researcher could not account for more of such requesters across EAJ.

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